

REMARKS

Claims 1-3 and 5-15 and new Claims 16 and 17 are active in the case.

Reconsideration is respectfully requested.

The present invention relates to a method of hydrogenating acetone to isopropanol product.

AMENDMENTS TO CLAIMS

Support for the presentation of new Claims 16 and 17 can be found on page 7, lines 8-14 of the text. Entry of the new claims into the record is respectfully requested.

Claim Rejection, 35 U.S.C. §112, First Paragraph

Claims 1-3, 5, 6 and 9-15 stand rejected based on 35 U.S.C. §112, first paragraph. This ground of rejection is respectfully traversed.

As to the matter of enablement, Applicants point out that they are in fact claiming a liquid-phase process of hydrogenating acetone to isopropanol, and in this context have described various types of catalyst systems on page 7 of the specification which enable the hydrogenation process. In fact a plural number of catalyst systems are disclosed, along with a preferred catalyst system of nickel on a neutral support. Further, neutral support materials have been disclosed which include α -Al₂O₃, titania, zirconia and mullite. Thus there is no question that Applicants have adequately described the types of catalyst systems which perform the liquid-phase hydrogenation of acetone in the present process. There is no requirement in patent law which would require Applicants to disclose every known hydrogenation catalyst for the hydrogenation of acetone to isopropanol in order to obtain

claims which are open to any hydrogenation catalyst useful for the hydrogenation of acetone to isopropanol. It is only incumbent upon Applicants to disclose the best mode of the invention, and this they have clearly done. If in fact there is a hydrogenation catalyst known in the art which is sufficient to hydrogenate acetone to isopropanol, and this catalyst is not disclosed in the present specification, nevertheless such a hydrogenation catalyst is within the purview of the present invention. Again the essential features of the hydrogenation process of this invention are the at least two stages of hydrogenation and the fact that the acetone reactant must contain no more than 1% by weight water. The present process as claimed is believed to be fully enabled and therefore withdrawal of the nonenablement ground of rejection of the claims is respectfully requested.

PRIOR ART REJECTION

As stated in the generic claim of record, the process of the present invention is directed to the hydrogenation of acetone by conducting the liquid-phase hydrogenation of acetone in at least two hydrogenation process stages thereby preparing the desired isopropanol product in high yield and selectivity with substantially reduced by-product production. The two essential features of the present process which enable the superior results of the hydrogenation of acetone are the fact that (1) the reaction is conducted in at least two successive hydrogenation stages and by the fact that (2) the hydrogenation of acetone is conducted under the condition of the acetone having a water content of $\leq 1\%$ by weight. In this regard Applicants point out that they have presented clear evidence in the record of the case of the importance or criticality of these two process aspects of the present invention. That is, the Example of the present application shows the hydrogenation of

acetone in two process stages using a nickel catalyst (10 % by weight Ni on a neutral α -Al₂O₃ support). The isopropanol product is obtained in a high yield of 99.45% while the amount of by-products is less than 100 ppm at the outlet of the second hydrogenation stage.

Accordingly, Applicants have demonstrated on the record the essential features of the present process which result in the production of isopropanol product in high yield and purity.

Claims 1-3 and 5-15 stand rejected based on 35 U.S.C. §103(a) as obvious over Fukuhara et al, U.S. Patent 5,081,321 in view of Hiles et al, U.S. Patent 4,626,604. This ground of rejection is respectfully traversed.

In his discussion of the Fukuhara et al reference on page 4 of the Office Action, the Examiner states that the Fukuhara et al reference is silent as to multiple hydrogenation stages, the percentage of water contained in the acetone reactant and the amount of by-products if any. The question in light of these admissions is why the present claims have been rejected over Fukuhara et al, since it is precisely these three features that constitute the present invention. Accordingly, the Examiner admits on the record that Fukuhara et al discloses no aspect of the broadly claimed invention as set forth in active Claim 1. Why then is the reference cited?

In fact, Fukuhara et al disclose an entirely different process of hydrogenating acetone to isopropanol where the hydrogenation process entails entirely different process features. That is, as described at the bottom of column 2 through the top of column 3 of the reference, the essential features of the hydrogenation process of the reference are that it is relegated to a fixed bed reaction system having a granular or particulate catalyst therein. In this reactor configuration, it is essential to conduct the direction of flow of reactant liquid and hydrogen gas over the catalyst in a specific direction. That is, it is critical to provide a cocurrent

liquid/gas down-flow relative to the fixed bed catalyst and to maintain the catalyst bed in a trickle bed state. These features which are critical to the process of Fukuhara et al are irrelevant as far as the process of the present invention is concerned. As is clear from the description above concerning the present invention, the important features of the hydrogenation process are that the acetone reactant contain no more than 1% by weight water and that the hydrogenation process be conducted in at least two hydrogenation stages. Accordingly, the Fukuhara et al reference appears to be of secondary interest.

As to the disclosure of Hiles et al, it is in fact not clear to Applicants how the Hiles et al reference can be combined with the disclosure of Fukuhara et al, since they are directed to two quite different aspects of aldehyde (ketone) hydrogenation. The aspect of improvement of the catalytic hydrogenation of aldehydes which Hiles et al have obtained is to conduct catalytic hydrogenation in at least three hydrogenation zones of which a first is a first catalytic stage, the second is a hydrogenation and at least one intermediate stage including a penultimate stage, followed by a final hydrogenation step. Each stage contains a charge of hydrogenation catalyst and the stages are connected in series so that the material from one stage is fed to the next stage in series. Other factors of the multistage hydrogenation process are disclosed in column 4 of the reference. Note in this regard that the Hiles et al reference specifically comments on the inadequacies of a plural stage hydrogenation where hydrogenation is conducted in only two stages. Apparently in a two stage process the operator of a hydrogenation process would not be able to compensate adequately for decline in catalyst activity without making certain adjustments to the process (column 5, lines 32-45). Accordingly, if there are in fact inadequacies of a two stage hydrogenation as stated by Hiles et al, and their solution is to provide a hydrogenation process of at least three stages, how

could such a disclosure lead the skilled artisan to the present invention where although more than two hydrogenation stages can be employed in the hydrogenation process, nevertheless a two stage process is adequate with the proviso that the water content of the acetone starting material be no more than 1 % by weight. Clearly there is no teaching or suggestion in Hiles et al of this critical feature of the present process, so that, whereas Hiles et al would lead the skilled artisan to conclude that a two stage hydrogenation of acetone is inadequate, to the contrary, in the present invention, at least two hydrogenation stages or steps are adequate as long as the water content limitation set forth in the present claims is maintained.

Applicants submit that to one of skill in the art desiring to improve the selectivity of a multistage hydrogenation process as disclosed in Hiles et al, would use, in view of the disclosure of Fukuhara et al, a trickle bed reactor under the very specific flow conditions taught in the Fukuhara et al reference. However, as pointed out immediately above, no motivation is provided to adjust the water content of the acetone starting material in event acetone is selected for the hydrogenation process. Clearly, not only does Fukuhara et al, as pointed out above, teach a process quite different from that of the present invention, likewise the Hiles et al reference fails to teach or suggest the invention.

With respect to a preferred aspect of the present invention in which the hydrogenation catalyst employs a neutral support, it is noted that whereas Fukuhara et al in column 2, lines 20-32 disclose several hydrogenation catalysts, although alumina supports are mentioned, none of the disclosed supports are neutral supports. In this connection it should be observed that it is known that alumina exists in several different modifications, but only $\alpha\text{-Al}_2\text{O}_3$ is a neutral support as disclosed in the present specification at page 7, line 14. As disclosed in Example 1 of the Fukuhara et al reference, Raney nickel is used, which is developed in an

aqueous sodium hydroxide solution. Thus it cannot be concluded from Fukuhara et al that a neutral support material for a catalyst is contemplated.

In conclusion, it is clear that neither Fukuhara et al nor Hiles et al teaches or suggests an at least two hydrogenation stage process of converting acetone to isopropanol product, where, besides the importance of using at least two hydrogenation stages, the acetone reactant must contain no more than 1 % by weight water. Thus, the process as claimed is believed patentably distinguished over the cited combination of patents.

It is now believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Norman F. Oblon
Attorney of Record
Registration No. 24,618

Frederick D. Vastine, Ph.D.
Registration No. 27,013



22850

(703) 413-3000
Fax #: (703)413-2220
FDV/js
I:\atty\FDV\93500169-AM.wpd

DOCKET NO.: 9350-0169-0
SERIAL NO.: 09/618,044

IN THE CLAIMS

Please add new Claims 16 and 17 as follows:

--16. (Newly Added) The process as claimed in Claim 1, wherein the liquid-phase hydrogenation reaction is conducted in the presence of a hydrogenation catalyst of copper, chromium, ruthenium or nickel on a Al_2O_3 , TiO_2 or ZrO_2 support.

17. (Newly Added) The process as claimed in Claim 1, wherein the liquid-phase hydrogenation reaction is conducted in the presence of a hydrogenation catalyst of a catalytically active metal on a neutral support selected from the group consisting of $\alpha\text{-Al}_2\text{O}_3$, TiO_2 , ZrO_2 or mullite.--